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(54) **SYSTEM AND METHOD FOR DETERMINING DRIVER IDENTIFICATION BY A REMOTE DEVICE**

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G08C 19/00 (2006.01)
B60R 25/24 (2013.01)

(52) **U.S. Cl.**
CPC ***B60R 25/245*** (2013.01); ***G08C 19/00*** (2013.01)

(58) **Field of Classification Search**
CPC G08C 19/00; B60R 25/245
See application file for complete search history.

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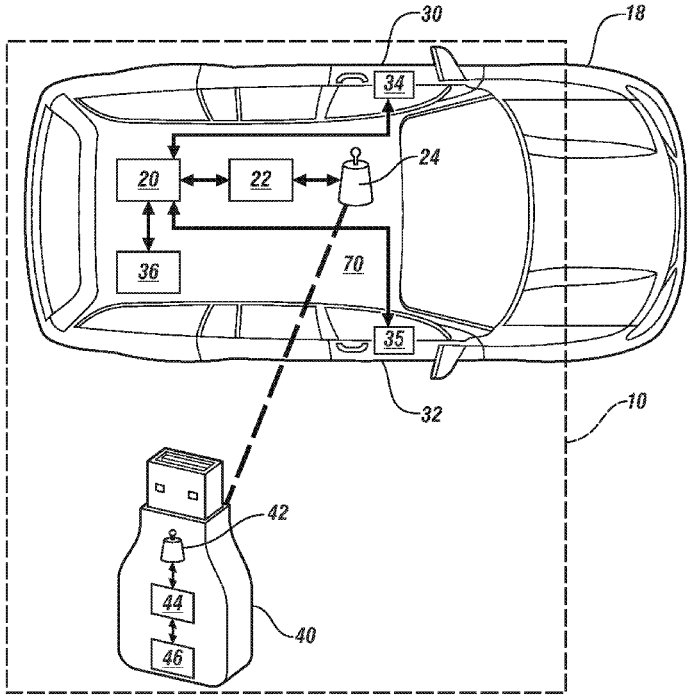
(57) **ABSTRACT**

A driver identification system for a vehicle is provided. The vehicle has a driver's side front door. The driver identification system includes at least one remote device, and a control module. The remote device is activated to send an authentication signal. The control module is in selective communication with the at least one remote device. The control module receives a signal indicating that the driver's side front door of the vehicle is opened. The control module includes control logic for sending an inquiry signal if the signal indicating the driver's side front door is opened is received by the control module. The inquiry signal is configured for activating the at least one remote device to send the authentication signal.

17 Claims, 3 Drawing Sheets



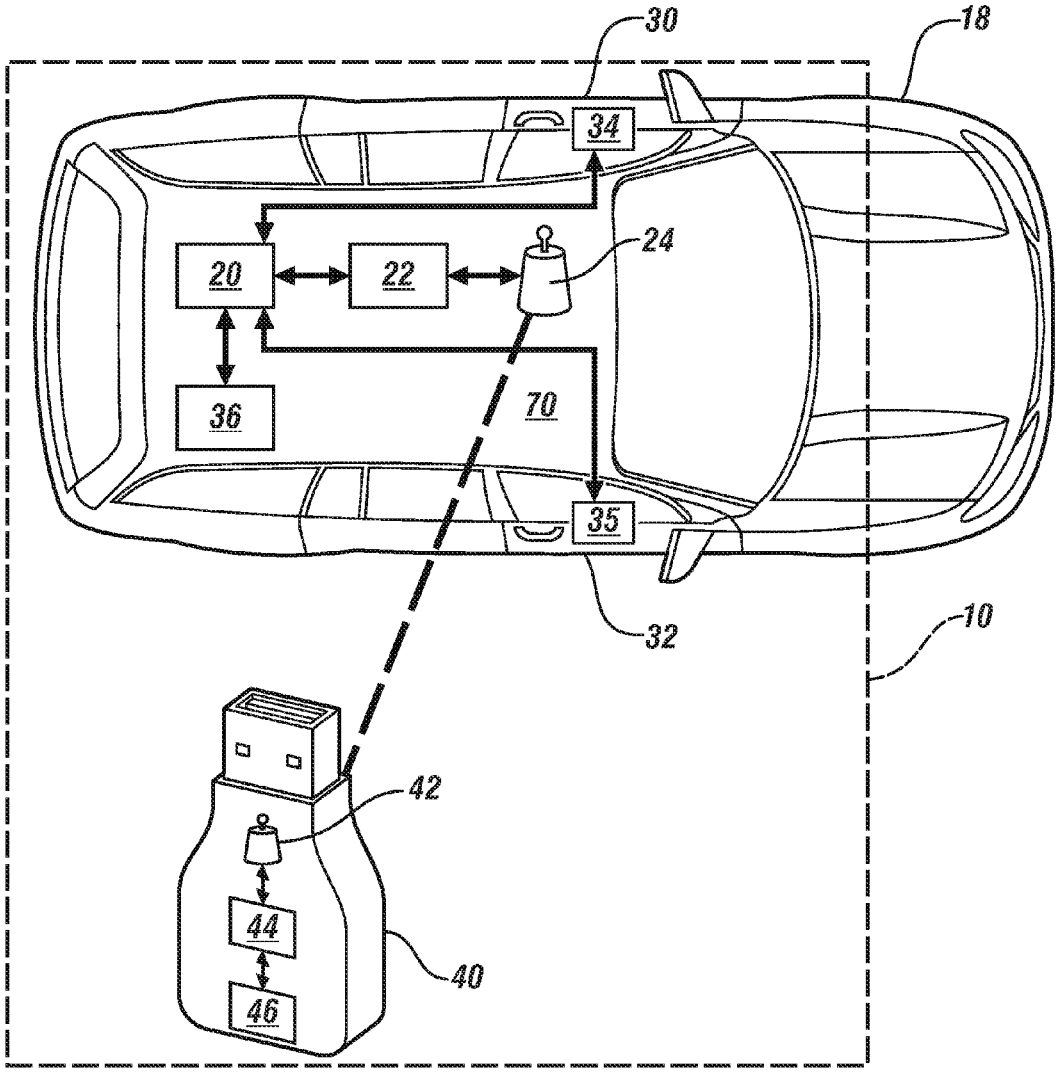


FIG. 1

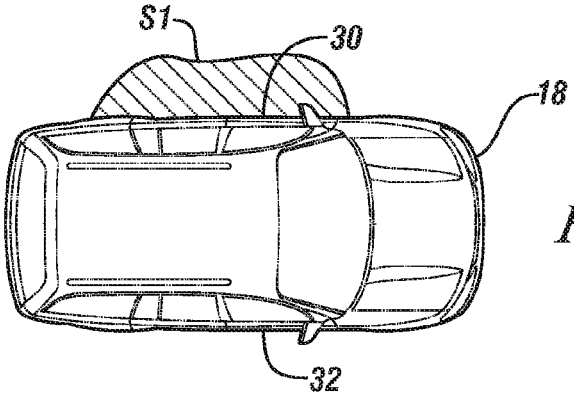


FIG. 2A

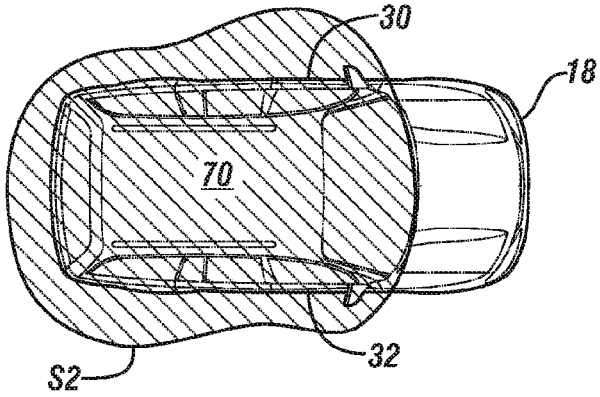


FIG. 2B

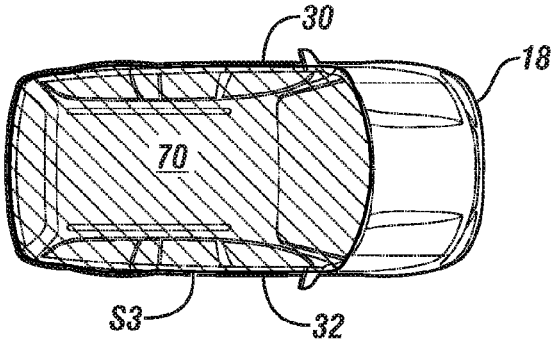


FIG. 2C

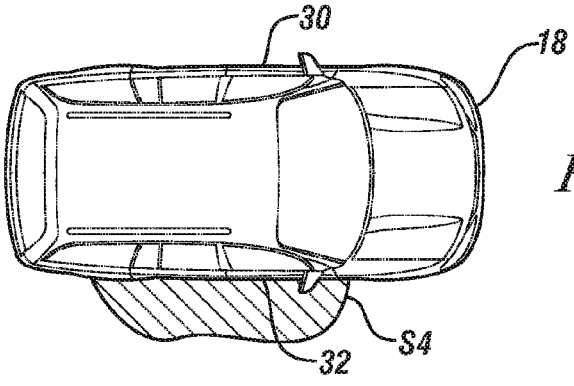


FIG. 2D

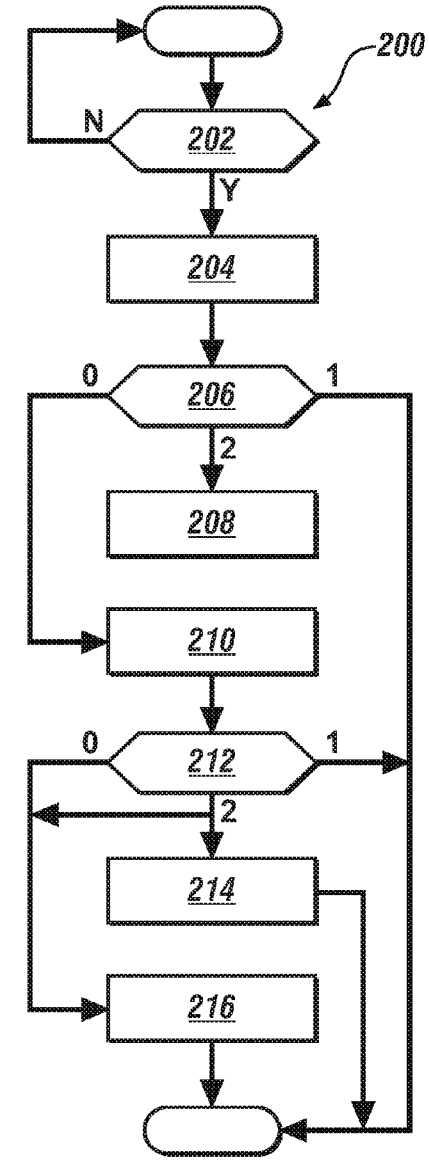


FIG. 3

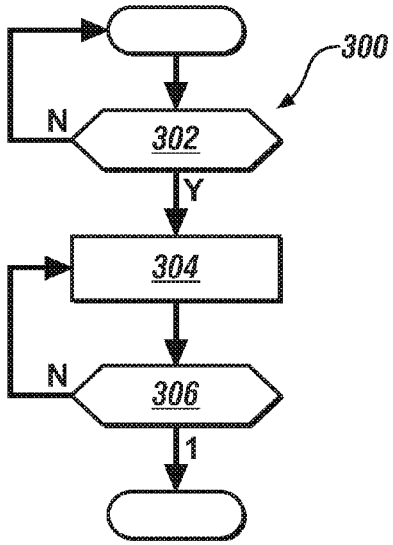


FIG. 4

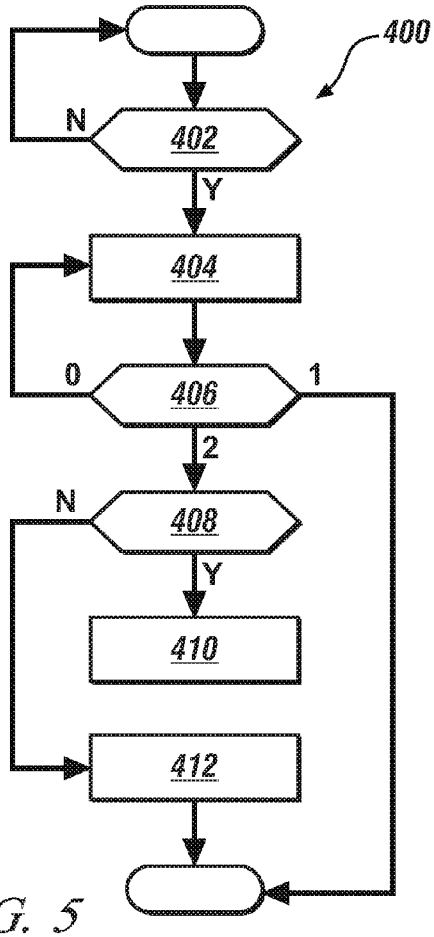


FIG. 5

SYSTEM AND METHOD FOR DETERMINING DRIVER IDENTIFICATION BY A REMOTE DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application claims priority to U.S. Provisional Patent Application Ser. No. 61/578,528, filed Dec. 21, 2011, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

Exemplary embodiments of the invention relate to a driver identification system for a vehicle and, more particularly, to a driver identification system for a vehicle including at least one remote device selectively activated to send an authentication signal.

BACKGROUND

Passive entry and starting systems perform the functions of unlocking the doors and starting a vehicle, without the need for a key. Specifically, a fob or other type of remote device unlocks the doors and starts a vehicle without a key.

Several fobs may be associated with a single vehicle. Each fob is associated with a specific individual. Thus, each fob may also provide a driver identifier to a control module of the vehicle, where the driver identifier indicates the specific individual who is the driver of the vehicle. Certain vehicle settings may be based on the driver identifier. For example, the driver identifier may indicate a specific individual's seat position. The driver identifier is dependent on the fob that is detected when the driver's side front door is unlocked. Specifically, a control module in the vehicle may send an inquiry signal (also referred to as a "challenge") to the fob in the event the driver's side front door is unlocked. If the fob receives the inquiry signal, the fob sends a corresponding signal back to the control module indicating the specific individual that the fob is associated with (the corresponding signal is also referred to as a "response"). The control module includes logic for decrypting the corresponding signal from the fob to determine the driver identifier. However, sometimes a driver may enter and start the vehicle with either the incorrect driver identifier, or with no driver identifier established. As a result, specific vehicle settings such as the driver's seat position are not adjusted accordingly.

One instance of the driver identifier not being established may occur if the driver first enters the vehicle through one of the passenger doors, and then places the fob in one of the passenger seats. In this example, the driver does not carry the fob on his or her person, but rather keeps the fob in an article of clothing (e.g., a jacket) or a carrying device (e.g., a backpack or a suitcase). The driver then opens the driver's side front door, is seated in the driver's seat, and starts the vehicle. However, because the driver did not carry the fob on his or her person and unlock the driver's side front door, the fob is unable to provide the driver identifier. Thus, vehicle settings such as the seat position will not be updated.

In another approach, a driver may enter an unlocked vehicle through the driver's side front door, and a passenger may also enter the vehicle through the passenger's door. The passenger carries the fob on his or her person. In this scenario, the fob is also unable to provide the correct driver identifier, and vehicle settings such as the seat position will not be adjusted. In yet another example, if a driver enters the vehicle through an unlocked driver's side front door, the fob is also unable to provide the correct driver identifier. Accordingly, it is desirable to provide a driver identification system for a vehicle that provides a driver identifier even if a driver does not unlock a driver's side front door while carrying the fob on his or her person.

SUMMARY OF THE INVENTION

In one exemplary embodiment of the invention, a driver identification system for a vehicle is provided. The vehicle has a driver's side front door. The driver identification system includes at least one remote device, and a control module. The remote device is activated to send an authentication signal. The control module is in selective communication with the at least one remote device. The control module receives a signal indicating that the driver's side front door of the vehicle is opened. The control module includes control logic for sending an inquiry signal if the signal indicating the driver's side front door is opened is received by the control module. The inquiry signal is configured for activating the at least one remote device to send the authentication signal.

In another exemplary embodiment of the invention, a vehicle having a driver identification system is provided. The driver identification system includes at least one remote device that is selectively activated to send an authentication signal. The vehicle includes a vehicle start module and a control module. The vehicle start module sends a signal indicating that the vehicle has been requested to start passively to a key-on state. The control module is in selective communication with the at least one remote device and in communication with the vehicle start module. The control module receives the signal from the vehicle start module. The control module includes control logic for sending an inquiry signal if the signal is received by the control module, the inquiry signal configured for activating the at least one remote device to send the authentication signal.

The above features and advantages and other features and advantages of the invention are readily apparent from the following detailed description of the invention when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features, advantages and details appear, by way of example only, in the following detailed description of embodiments, the detailed description referring to the drawings in which:

FIG. **1** is an exemplary schematic illustration of a vehicle having a driver identification system;

FIGS. **2A-2D** are illustrations of a control module shown in FIG. **1** sending an inquiry signal;

FIG. **3** is a process flow diagram of one example of operating the driver identification system in FIG. **1**;

FIG. **4** is a process flow diagram of another example of operating the driver identification system in FIG. **1**; and

FIG. **5** is a process flow diagram of yet another example of operating the driver identification system in FIG. **1**.

DESCRIPTION OF THE EMBODIMENTS

The following description is merely exemplary in nature and is not intended to limit the present disclosure, its application or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features. As used herein, the term module refers to an application specific integrated circuit (ASIC), an electronic circuit, a processor (shared, dedicated,

or group) and memory that executes one or more software or firmware programs, a combinational logic circuit, and/or other suitable components that provide the described functionality.

Referring now to FIG. **1**, an exemplary embodiment is directed to a driver identification system **10** employed in a vehicle **18**. The driver identification system **10** includes a control module **20**, a transceiver **22**, an antenna **24**, a driver's side front door **30**, a passenger's side front door **32**, a driver's side front door latching system **34**, a passenger's side front door latching system **35**, a vehicle start module **36** and at least one remote device **40**. In the embodiment as shown in FIG. **1**, the at least one remote device **40** is a key fob. However, the remote device **40** may be any portable device that a user may carry either on his or her person or in a wallet or purse such as, for example, a card. In the embodiment as shown, the driver identification system **10** is a passive entry and starting system where the remote device **40** performs the functions of unlocking the doors **30**, **32** and starting the vehicle **18**, without the need for a key.

The control module **20** is in selective wireless communication with the remote device **40** through the transceiver **22** and the antenna **24**. The remote device **40** may include an antenna **42**, a transceiver **44**, and a control module **46**. The remote device **40** is associated with a specific individual. In one embodiment, multiple remote devices **40** may be associated with the driver identification system **10**, where each remote device **40** is associated with a specific individual. The control module **46** of the remote device **40** may include a memory that stores information indicating the specific individual that is associated with the remote device **40**.

The control module **20** of the vehicle **18** also includes a memory that stores specific settings associated with at least one driver profile. The driver profiles stored in the control module **20** are each associated with a specific individual, and include vehicle settings that are customized for the specific individual such as, for example, seat position. The control module **20** may be in communication with one or more control modules (not shown) that may update specific vehicle settings based on a current driver profile of the vehicle **18**. For example, in one embodiment, the control module **20** may be in communication with a driver's seat control module, where a position of a driver's seat (not shown) may be adjusted based on the current driver of the vehicle **18**.

The control module **20** is configured for selectively sending an inquiry signal to the remote device **40** in the event the doors **30**, **32** of the vehicle **18** have been opened, or unlocked. In one exemplary embodiment, the inquiry signal is a low frequency signal ranging from about 125 to about 135 kHz. If the remote device **40** is located within a specific range of the antenna **24** of the vehicle **18**, the antenna **42** of the remote device **40** receives the inquiry signal. The remote device **40** is selectively activated to send an authentication signal back to the antenna **24**. Specifically, upon receipt of the inquiry signal, the control module **46** of the remote device **40** sends an authentication signal that is received by the antenna **24** of the vehicle **18**. In one exemplary embodiment, the authentication signal is an ultra-high frequency signal ranging from about 315 MHz to about 433.9 MHz. In the event the control module **20** receives the authentication signal from the remote device **40**, the control module **20** includes control logic for updating the current driver profile of the vehicle **18** with the specific individual associated with the remote device **40**, which is discussed below and described in FIGS. **3-5**.

The control module **20** monitors the driver's side front door latching system **34** and the passenger's side latching system **35** to determine if the driver's side front door **30** or the passenger's side front door **32** are opened or unlocked. Alternatively, in another exemplary embodiment, a door control module (not illustrated) may be in communication with the control module **20** to send a signal indicating that the driver's side front door **30** or the passenger's side front door **32** are opened or unlocked.

The control module is also in communication with the vehicle start module **36**. The vehicle start module **36** sends a signal to the control module **20** indicating whether the vehicle **18** is in a key-on or a key-off state. Specifically, the vehicle start module **36** indicates whether the vehicle **18** has been requested to passively start to the key-on state. A passive or keyless start of the vehicle **18** may occur in the event a driver presses a starter button or twists an ignition switch or other start request control (not illustrated), with the remote device **40** located within an interior cabin **70** of the vehicle **18**. It should be noted that while the terms key-on and key-off are used, a key is generally not employed. Instead, the key-on state exists when power is supplied to a propulsion system (not shown) of the vehicle **18**. The key-off state exists when power is not supplied to the propulsion system.

FIGS. **2A-2D** illustrate the vehicle **18** with different configurations of the control module **20** (shown in FIG. **1**) sending the inquiry signal. Specifically, shaded areas **S1-S4** (shown in FIGS. **2A-2D**, respectively) illustrate the different ranges that may be covered by the inquiry signal. FIG. **2A** illustrates a shaded region **S1**, where the inquiry signal covers a controlled region around the outside of or exterior to the driver's side front door **30**. In one embodiment, the shaded region **S1** extends about two meters outside of or exterior to the driver's side front door **30**. FIG. **2B** illustrates a shaded region **S2**, which covers substantially the entire interior cabin **70** of the vehicle **18**, as well as an exterior region outside of the vehicle **18**. In one embodiment, the shaded region **S2** extends about two meters around the exterior region of the vehicle **18**. FIG. **2C** illustrates a shaded region **S3** that covers substantially the entire interior cabin **70** of the vehicle **18**. FIG. **2D** illustrates a shaded region **S4**, which covers a controlled region around the outside of or exterior to the passenger's side front door **32**. In one embodiment, the shaded region **S4** extends about two meters from the passenger's side door **32**. Although a measurement of two meters is discussed, it is to be understood that the measurements discussed are exemplary embodiments and that other measurements may be used as well.

A method of operating the driver identification system **10** will now be explained. Referring to FIG. **3**, an exemplary process flow diagram illustrating an exemplary process of operating the driver identification system **10** is generally indicated by reference number **200**. With reference to FIGS. **1-3**, process **200** begins at step **202**, where the control module **20** monitors and determines if the driver's side front door **30** has been opened. Specifically, with reference to FIGS. **1** and **3**, the control module **20** monitors the driver's side front door latching system **34** to determine if the driver's side front door **30** has been opened. Once the driver's side front door **30** is opened, process **200** may then proceed to step **204**.

In step **204**, the control module **20** sends the inquiry signal to the shaded region **S1** (which is illustrated in FIG. **2A**) in the event the driver's side front door **30** is opened. Process **200** may then proceed to step **206**.

In step **206**, the control module **20** monitors the antenna **24** through the transceiver **22** for the authentication signal. In one embodiment, only 1 authentication signal from a single remote device **40** is received by the control module **20**. In this case, the control module **20** may update the current driver

profile with the driver identifier associated with the remote device **40** that sent the authentication signal. Process **200** may then terminate.

In the event two or more remote devices **40** send authentication signals back to the control module **20** though the antenna **24**, then process **200** may proceed to step **208**, where the control module **20** utilizes the last current driver profile that is saved in the memory of the control module **20** as the current driver profile. Process **200** may then terminate.

In the event no authentication signal is received by the antenna **24** and sent to the control module **20**, process **200** may then proceed to step **210**. In step **210**, the control module **20** sends the inquiry signal to the entire interior cabin **70** of the vehicle **18**, as well as an exterior region outside of the vehicle **18** (which is illustrated as the shaded region S2 in FIG. **2**B). Process **200** may then proceed to step **212**.

In step **212**, the control module **20** monitors the antenna **24** through the transceiver **22** for the authentication signal. In one embodiment, only 1 authentication signal from a single remote device **20** is received by the control module **20**. In this case, the control module **20** may update the current driver profile with the specific individual associated with the remote device **40** that sent the authentication signal. Process **200** may then terminate.

In the event no authentication signal is received by the antenna **24** and sent to the control module **20**, process **200** may return to step **210** at least once, where the inquiry signal may be resent. That is, in the event that no authentication signal is received, process **200** may return to step **210** at least once to create a retry sequence for robustness. In the event that no authentication signal is received even after process **200** has repeated steps **210** and **212** at least once, process **200** may proceed to step **216**, where the control module **20** utilizes the last current driver profile that is saved in the memory of the control module **20**. Process **200** may then terminate.

In the event two remote devices **40** send authentication signals back to the control module **20** though the antenna **24**, then process **200** may proceed to step **214**. In step **214**, if the passenger's side front door **32** has been opened within a specified time frame of the driver's side door **30** being opened in step **202** (e.g. in one embodiment the specified time is about thirty seconds), the control module **20** includes control logic for determining if a passenger identifier has been established. FIG. **4** is an illustration of a process flow diagram illustrating an exemplary approach for determining the passenger identifier, and is discussed in detail below. In the event a passenger identifier has been established, process **200** may then proceed to step **214**. In the event no passenger identifier has been established, process **200** may then proceed to step **216**, where the control module **20** utilizes the last current driver profile that is saved in the memory of the control module **20**. Process **200** may then terminate.

In step **214**, the control module **20** determines the current driver profile by selecting the remote device **40** that is not established as the passenger identifier as the current driver profile. Process **200** may then terminate.

FIG. **4** is an exemplary process flow diagram illustrating an exemplary process of establishing the passenger identifier generally indicated by reference number **300**. With reference to FIGS. **1**-**2** and **4**, process **300** begins at step **302**, where the control module **20** monitors and determines if the passenger's side front door **32** has been opened. Specifically, with reference to FIGS. **1** and **4**, the control module **20** monitors the passenger's side front door latching system **35** to determine if the passenger's side front door **32** has been opened. Once the passenger's side front door **32** is opened, process **300** may then proceed to step **304**.

In step **304**, the control module **20** sends the inquiry signal to the shaded region S4 (which is illustrated in FIG. **2**D) in the event the passenger's side front door **32** is opened. Process **300** may then proceed to step **306**.

In step **306**, the control module **20** monitors the antenna **24** through the transceiver **22** for the authentication signal. In the event a single authentication signal from the remote device **40** is received by the control module **20**, the control module **20** may establish the passenger identifier with the driver identifier associated with the remote device **40** that sent the authentication signal. Process **300** may then terminate. In the event no authentication signal is received from the remote device **40**, process **200** may return to step **304** and repeat process **200** at least once.

FIG. **5** is an exemplary process flow diagram illustrating an exemplary process of operating the driver identification system **10**, where a request has been made to passively start the vehicle **18** (e.g., a driver presses a starter button or twists an ignition switch). Specifically, with reference to FIGS. **1** and **5**, process **400** begins at step **402**, where the control module **20** monitors and determines if the vehicle **18** has been requested to start passively. Referring to FIG. **1**, the control module **20** is in communication with the vehicle start module **36**. The vehicle start module **36** sends a signal to the control module **20** indicating whether the vehicle **18** has been requested to start passively to the key-on state. Once the vehicle **18** has been requested to start passively to the key-on state, process **400** may then proceed to step **404**.

In step **404**, the control module **20** sends the inquiry signal to the shaded region S3 (which is illustrated in FIG. **2**C) in the event the vehicle **18** has been requested to start passively to the key-on state. Process **400** may then proceed to step **406**.

In step **406**, the control module **20** monitors the antenna **24** through the transceiver **22** for the authentication signal. In one embodiment, only one authentication signal from a single remote device **20** is received by the control module **20**. In this case, the control module **20** may update the current driver profile with the driver identifier associated with the remote device **40** that sent the authentication signal. Process **400** may then terminate.

In the event no authentication signal is received by the antenna **24** and sent to the control module **20**, process **400** may then return to step **404**. Process **400** may repeat step **404** at least once, and if no authentication signal is still received by the antenna **24**, the control module **20** utilizes the last current driver profile that is saved in the memory of the control module **20**. Process **400** may then terminate.

In the event two remote devices **40** send authentication signals back to the control module **20** though the antenna **24**, then process **200** may proceed to step **408**. In step **408**, if the passenger's side front door **32** has been opened, the control module **20** includes control logic for determining if the passenger identifier has been established. As discussed above and illustrated in FIG. **4**, in the event a passenger identifier has been established, process **400** may then proceed to step **410**. In the event no passenger identifier has been established, process **400** may then proceed to step **412**, where the last current driver profile that is saved in the memory of the control module **20**. Process **400** may then terminate.

In step **410**, the control module **20** determines the current driver profile by selecting the remote device **40** that is not established as the passenger identifier as the current driver profile. Process **400** may then terminate.

While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without

departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed, but that the invention will include all embodiments falling within the scope of the application.

What is claimed is:

1. A driver identification system for a vehicle, the vehicle having a driver's side front door and a passenger's side front door, the driver identification system comprising:

at least one remote device selectively activated to send an authentication signal;

a control module that is in selective communication with the at least one remote device, the control module receiving a signal indicating that the driver's side front door of the vehicle is opened, the control module includes control logic for:

sending an inquiry signal if the signal indicating the driver's side front door is opened is received by the control module, the inquiry signal configured for activating the at least one remote device to send the authentication signal;

based on receiving a single authentication signal in response to the inquiry signal, updating a current driver profile with a driver identifier associated with the single authentication signal;

sending a second inquiry signal in the event the authentication signal is not received by the control module, wherein the second inquiry signal is sent to an interior of the vehicle and a surrounding exterior region of the vehicle;

based on receiving a response to the second inquiry signal, the response including the authentication signal, updating the current driver profile with a driver identifier associated with the authentication signal, and

based on the control module receiving authentication signals from two remote devices in response to the second inquiry signal, the control module determines if a passenger identifier has been previously established and updates the current driver profile with a driver identifier associated with the authentication signal not associated with the passenger identifier.

2. The driver identification system as recited in claim **1**, wherein the inquiry signal is sent to a driver's side region that is located exterior to the driver's side front door.

3. The driver identification system as recited in claim **1**, wherein the control module includes control logic for utilizing a last driver profile saved in a memory of the control module if a second authorization signal is not received after the second inquiry signal is sent.

4. The driver identification system as recited in claim **1**, wherein the control module includes control logic for determining a current driver profile by selecting one of the two remote devices that has not been established as the passenger identifier as the current driver profile.

5. The driver identification system as recited in claim **1**, wherein if two or more remote devices send the authentication signal back to the control module, the control module includes control logic for utilizing a last current driver profile saved in a memory of the control module as a current driver profile.

6. The driver identification system as recited in claim **5**, wherein the current driver profile includes customized vehicle settings.

7. The driver identification system as recited in claim **5**, wherein the current driver profile includes a customized seat position for a driver's seat.

8. The driver identification system as recited in claim **1**, wherein if a single authentication signal from a single remote device is received by the control module, the control module includes control logic for updating a current driver profile with an individual identifier associated with the single remote device that sent the single authentication signal.

9. The driver identification system as recited in claim **1**, wherein if a passenger's side front door is opened within a specified time frame of the driver's side door being opened, the control module includes control logic for sending a passenger inquiry signal to a passenger's side region located exterior to the passenger's side front door.

10. The driver identification system as recited in claim **9**, wherein if a single passenger authentication signal is received by the control module after the passenger inquiry signal is sent, the control module includes control logic for establishing the passenger identifier to be the same as an individual identifier associated with a remote device that sent the single passenger authentication signal.

11. A vehicle having a driver identification system comprising:

at least one remote device selectively activated to send an authentication signal;

a vehicle start module that sends a signal indicating that the vehicle has been requested to start passively to a key-on state; and

a control module that is in selective communication with the at least one remote device and in communication with the vehicle start module, the control module receiving the signal from the vehicle start module, the control module including control logic for:

sending an inquiry signal if the signal is received by the control module, the inquiry signal configured for activating the at least one remote device to send the authentication signal;

based on receiving a single authentication signal in response to the inquiry signal, updating a current driver profile with a driver identifier associated with the single authentication signal;

sending a second inquiry signal in the event the authentication signal is not received by the control module, wherein the second inquiry signal is sent to an interior of the vehicle and a surrounding exterior region of the vehicle; and

based on receiving a response to the second inquiry signal, the response including the authentication signal, updating the current driver profile with a driver identifier associated with the authentication signal;

wherein based on the control module receiving authentication signals from two remote devices in response to the second inquiry signal, the control module determines if a passenger identifier has been previously established and updates the current driver profile with a driver identifier associated with the authentication signal not associated with the passenger identifier.

12. The vehicle as recited in claim **11**, wherein the inquiry signal is sent to substantially an entire interior cabin of the vehicle.

13. The vehicle as recited in claim **11**, wherein the control module includes control logic for re-sending the inquiry signal at least once if the control module does not receive the authentication signal from the at least one remote device.

14. The vehicle as recited in claim **11**, wherein the control module includes control logic for determining a current driver

profile by selecting one of the two remote devices that has not been established as the passenger identifier as the current driver profile.

15. The vehicle as recited in claim **11**, wherein if a single authentication signal from a single remote device is received by the control module, the control module includes control logic for updating a current driver profile with an individual identifier associated with the single remote device that sent the single authentication signal.

16. The vehicle as recited in claim **11**, wherein if a passenger's side front door is opened within a specified time frame of a driver's side door being opened, the control module includes control logic for sending a passenger inquiry signal to a passenger's side region located exterior to the passenger's side front door.

17. The vehicle as recited in claim **16**, wherein if a single passenger authentication signal is received by the control module after the passenger inquiry signal is sent, the control module includes control logic for establishing the passenger identifier to be the same as an individual identifier associated with a remote device that sent the single passenger authentication signal.

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